



Original communication

Pesticide poisoning cases in Ankara and nearby cities in Turkey: An 11-year retrospective analysis

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ABSTRACT

Since they are available in open markets and pharmacies, pesticides have been widely used all over the country. (Un)intentional poisoning with these compounds is one of the most common causes of chemical poisoning, especially in rural agricultural areas. Pesticide poisonings reported by various countries showed that it is a worldwide health problem with 250 000–370 000 associated deaths each year.

In this study, medico-legal deaths between the years 2001 and 2011 in Ankara and nearby cities in Turkey were investigated retrospectively. The autopsies were partly carried out by Ankara Branch of Council of Forensic Medicine. Data were collected from reports of the Morgue Department whose toxicological analyses were performed in the Chemistry Department. The data revealed that 70 cases out of 10 720 autopsied ones had been attributed to fatal pesticide poisoning. The age range was 1–80 years (mean \pm SD, 41.33 \pm 17.42 years). Most of the cases (60%) were reported from Ankara. Insecticides were the most common (94%) cause of fatal pesticide poisonings, most of them (63%) being organophosphate insecticides. The percentages of pesticide-induced deaths are quite high in our society and should therefore not be underestimated. Accordingly, intensive efforts to reduce occupational and intentional pesticide poisonings are urgently needed in Ankara and nearby cities.

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1. Introduction

Although often misunderstood as referring to insecticides only, the term pesticide also applies to herbicides, fungicides and other substances used to control pests. Pests are living organisms that occur where they are not wanted or that cause damage to plants, humans or other animals. Some examples would be insects, mice and other animals, unwanted plants, fungi, microorganisms such as bacteria and viruses. Pesticide production, sale and use have medico-legal aspects.

Pesticide poisoning is a major public health problem all over the world. Each year 250 000–370 000 people die from deliberate

ingestion of pesticides.¹ The World Health Organization (WHO) recognises pesticide poisoning to be the single most important means of suicide worldwide.² Unprotected and indiscriminate use of pesticides represents both a human health and an environmental problem. Poisoning occurs as a result of agricultural use, accidental exposure, suicide and homicide.³

Although most pesticides (80%) are used in rich countries, most of the poisonings do ensue in poor countries. This is because safety standards are inadequate, there are no protective clothing or washing facilities, insufficient enforcement and poor labelling of pesticides used by farmers who may even not be able to read. Further, few people know enough about pesticide hazards. For example, farmers who utilize pesticides have a significantly higher rate of cancer incidence than non-farmers.⁴

WHO has classified the toxic effects of pesticides from class Ia (extremely hazardous) to class III (slightly hazardous).⁵ Most class-I technical grade pesticides are banned or strictly controlled in the

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regulated industrialised world, but not in developing countries where class-I pesticides are widely available in open markets and pharmacies, and which do not have the resources for their safe use either.

There are few studies about pesticide poisonings and their harmful effects in Turkey.^{6–10} Moreover, there are actually no data from Ankara (the capital of Turkey located geographically in the middle of the country) and nearby cities. Therefore, in this study, we have investigated retrospectively the medico-legal deaths from that areas between the years 2001 and 2011, and to the best notice of the authors, our data will be the first in this regard.

2. Materials and methods

This study was approved by the ethical committee of the Council of Forensic Medicine upon application by the authors.

Between 2001 and 2011, Ankara Branch of the Council of Forensic Medicine performed 10 720 autopsies at the Morgue Department from the records of which cases with positive results for pesticides were identified.

Toxicological analyses were carried out at the Chemistry (Toxicology) Department from biological samples (blood, urine, gastric content, etc.) sent from either the Morgue Department or other places where the medico-legal autopsies were performed. Thin-layer chromatography (TLC), gas chromatography–mass spectrometry (GC/MS) and liquid chromatography–tandem mass spectrometry (LC/MS/MS) were used during analyses. Samples that were positive for pesticides on TLC were extracted by liquid–liquid extraction method and analysed with GC/MS or LC/MS/MS to confirm the results.

Statistical Package for Social Sciences (SPSS) version 16.0 was used to analyse the data.

3. Results

There were 622 fatal poisonings out of 10 720 autopsies and 70 (50 M, 19 F, 1 unknown; with a M/F ratio of 2.63/1) cases (11%) had been attributed to fatal poisonings of pesticides. The age range of the subjects was 1–80 years (mean \pm SD, 41.33 \pm 17.42 years). Most of the cases (60%) were reported from Ankara where the autopsies had been most commonly performed (Table 1). Insecticides were the highest cause of fatal pesticide poisonings (94%) – mostly being due to organophosphates (63%) (Tables 2 and 3). 2,2-Dichlorovinyl dimethyl phosphate (DDVP) (25.7%) and endosulfan (15.7%) were the two most common pesticides responsible for death. We were not able to determine the types of 11 organophosphates due to inadequate data. Pesticide poisoning-related deaths occurred mostly in 2011 ($N = 12$), 2009 ($N = 9$), 2010 ($N = 8$) and 2007 ($N = 7$), respectively (Table 4).

Table 1
Distribution of cases according to cities.

City	Number of cases	Percent
Aksaray	7	10
Amasya	1	1.4
Ankara	42	60
Bartın	1	1.4
Bolu	1	1.4
Çankiri	2	2.9
Çorum	2	2.9
Kastamonu	3	4.3
Kırıkkale	3	4.3
Kırşehir	3	4.3
Nevşehir	2	2.9
Yozgat	2	2.9
Zonguldak	1	1.4
Total	70	100

Table 2

The types of pesticides used in fatal poisonings.

Pesticide	Number	Percent
Acid isoethylester	1	1.4
Aluminium phosphide	1	1.4
Amitraz	1	1.4
Azinphos methyl	1	1.4
Basudin	1	1.4
Chlorpyrifos	2	2.9
Cypermethrin	1	1.4
DDVP (dimethyl 2,2-dichlorovinyl phosphate)	18	25.7
Diazinon	2	2.9
DNOC (3,5-dinitro-o-cresol)	4	5.7
Endosulfan	11	15.7
Methomyl	4	5.7
Carbofuran	1	1.4
Megasulfan	1	1.4
Methidathion	1	1.4
Omethoate	2	2.9
Organic chlorine	2	2.9
Parathiomethyl	4	5.7
Propamocarb	1	1.4
Organophosphate insect. (unknown)	11	15.7
Total	70	100

Although the places of deaths were mainly hospitals (45.7%) (Table 5), the reason for death and the exact places where poisoning took place were not reported. We could not find any reports about suicidal attempts but according to the following places of death, we considered them (12 cases, 17%) as suicidal deaths: four cases occurred in their own houses, five in hotels, one in a school rest-room, one under a coalhouse and one in a car. The cases that occurred in hospitals and were reported with full addresses can be related with either suicidal or accidental cases. We have obtained our data from the official documents of the Morgue Department. The manner of deaths could not be determined from provided documents by the related sections.

4. Discussion

Poisoning of pesticides is still an important problem in Turkey, especially in rural areas. Their wide and easy availability makes them also a popular way of self-poisoning.

There are publications about (un)intentional poisonings of pesticides in the literature from various countries. In a recent study by Idiz et al., regarding deaths caused by pesticide poisoning between 2006 and 2009 in İzmir (located in the Aegean region (west coast) of Turkey), 48 cases out of 54 autopsies were positive for pesticides, organophosphates being the most common.^{5,6} Suicidal poisonings were higher (80%) than accidental poisonings (8%). Yaycı et al. found the ratio of pesticide-caused deaths to all poisonings as 49.5% in the Mediterranean region (south coast), 41.2% in the Aegean region and 5.3% in the Marmara region (northwest) of our country.¹¹ Yet, the Mediterranean and Aegean regions are the areas where agricultural products (predominantly fruits) are widely grown in Turkey. Increased use of pesticides increases their harmful effects such as diseases, accidents and suicides as reported in various studies.^{1,9,10,12}

Table 3

The types of pesticides.

Pesticide	Number	Percent
Insecticide	66	94.28
Herbicide	1	1.42
Antiparasitic	1	1.42
Fungicid + Fumigant	2	3.03
Total	70	100

Table 4

The distribution of the cases according to years.

Year	Number of cases	Percent
2001	6	8.6
2002	3	4.3
2003	6	8.6
2004	5	7.1
2005	5	7.1
2006	5	7.1
2007	7	10
2008	4	5.7
2009	9	12.9
2010	8	11.4
2011	12	17.1
Total	70	100

Birincioglu et al. reported that 17.2% of poisonings were attributed to insecticides in a retrospective study of the forensic records from the Trabzon Branch of the Council of Forensic Medicine (located in the Black Sea region (north coast) of Turkey).¹³ Nesime et al. determined the spectrum of deaths due to acute agrochemical poisoning in Turkey from all autopsy reports performed between 1997 and 2001, compiled by the Institute of Forensic Medicine. Of 205 deaths, 153 (75%) were suicides and the most common substance (used) was insecticides followed by sulphur, rodenticides and herbicides.¹¹ On the other hand, in a prospective cohort study, Dawson et al. reported that organophosphates (11.2%) and organochlorines (endosulfan) (16.7%) were the most commonly used fatal pesticides in patients who presented to two Sri Lankan rural referral hospitals. They found a large variation in human case fatality between single pesticides (0–42%).¹ In a study conducted between 1998 and 2004, substances of abuse were implicated in 22 cases (47.8%), pesticides in 9 cases (19.6%), gases in eight cases (17.4%), corrosives in 4 cases (8.7%), and prescription drugs in 3 cases (6.5%).¹⁴ Ait El Cadi et al. determined the frequency of fatal pesticide poisoning in Morocco between 2000 and 2005 as 4.2% out of 3104 analyses performed in the Laboratory of Forensic Toxicology.¹⁵ Insecticides were the most frequent cause of fatal pesticide poisoning (75.2%), organophosphates being the most common (55.4%). The ratio of suicidal cases were 23.1%, accidentals were 1.5% and 75% were uncertain cases. Occupational exposures were the most frequent type (38.5%), followed by accidentals (33.8%) and suicidal attempts (22.5%), as reported by Leveridge in Costa Rica during 1996.¹⁶ In another study from Brazil, insecticides were shown to be involved in 75.7% of all poisonings that had occurred between 1992 and 2002.¹⁷ Methamidophos, carbofuran and monochrotophos were the primary insecticides but dimethoate was associated with the highest fatal ratio (30.8%) followed by endosulfan (23.5%).

Pesticides are reported as one of the most common poisons used for suicide purposes.^{5,17–21} On the other hand, Chang et al. recently reported that pesticide suicides showed a 67% reduction from 7.7

Table 5

The places of deaths.

Place	Number of cases	Percent
Full addressed places	7	10
Hospital	32	45.7
Hotel	5	7.1
In a car	1	1.4
Public place	2	2.8
Empty place	4	5.7
Built-up area	1	1.4
School-restroom	1	1.4
Under a coalhouse	1	1.4
Unknown address	10	14.3
Own house	4	5.7
Unreported	2	2.8
Total	70	100

per 100 000 (42% of all suicides) in 1987 to 2.5 per 100 000 (12% of all suicides) in 2010, in contrast to a 69% increase in suicide rates by other means.²² This betterment caused a 66% fall in the workforce involved in agriculture but there was lack of any connection with trends in pesticide sales, bans on selected pesticide products or unemployment.

The present study showed similar results with the aforementioned reports in many aspects. During the 10 years (2001–2011), 70 cases (11%) (M > F) were identified as pesticide poisonings and the major substances were DDVP (25.7%) and endosulfan (15.7%). The workers in agriculture or other pesticide-related areas are mostly males and it is easy for them to access pesticides. Occupational illness or poisoning due to pesticides is common because safety equipment use and the relevant control are difficult.²³ Being unaware of the negative effects of pesticides on human and environmental health, the producers and farmers use excessive amounts and incorrectly.

As in many developing countries, our study has shown that organophosphate insecticides were the main pesticide causing poisoning and consequently death.^{3,14,24} Organophosphates cause the inhibition of acetylcholinesterase (AChE) by phosphorylating the serine hydroxyl residue on AChE, leading to the accumulation of acetylcholine (ACh) in the body. AChE is critical for nerve function and the irreversible blockage of this enzyme results in muscle overstimulation. DDVP – a highly hazardous (class IIb) pesticide according to WHO⁴ – was the most commonly found organophosphate in toxicological analyses. The other common organophosphates (class IIb) were dinitro-ortho-cresol (DNOC) and methomyl in the present study. Again similar to other studies,^{1,15} we observed that endosulfan was the second most frequent pesticide causing death. It is a moderately hazardous (class II) organochlorine pesticide with AChE activity.

Due to the lack of adequate information in the records, there are some limitations in our study. The manner of death could not be determined in many cases. Simply because the autopsies had been performed in other cities and only biological samples such as blood, urine, organs, etc. had been sent to our laboratory. According to the available data, we may say that the most poisonings were unintentional but that the intentional ones should not be disregarded as well.

As a conclusion, epidemiological and toxicological data suggest that many pesticide-related deaths might be prevented if the use of most toxic pesticides to humans was restricted, they could be safely stored and the accessibility and quality of care for poisoning could be improved. There is definitely need for in-depth investigation of pesticide poisonings and application of legal/educational preventing programmes that would minimise the risk of (un)intentional poisonings.

Ethical approval

This study was approved by the ethical committee of the Council of Forensic Medicine.

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Conflict of interest

The authors assert that they have no conflict of interest of financial interests in this study.

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